

TITLE: CITATION PARAMETERS OF CONTACT LENS RELATED ARTICLES PUBLISHED IN THE OPHTHALMIC LITERATURE

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ABSTRACT

Objectives: The present study aimed at exploring the citation parameters of contact lenses articles published in the Ophthalmology thematic category of the Journal Citation Reports (JCR).

Methods: The Thompson Reuters Web of Science database was accessed to record bibliometric information and citation parameters of all journals listed under the Ophthalmology area of the 2011 JCR edition, including the journals with main publication interests in the contact lens field. In addition, the same database was employed to unveil all contact lens related articles published in 2011 in the same thematic area, whereupon differences in citation parameters between those articles published in contact lens and non-contact lens related journals were explored.

Results: Significant differences in some bibliometric indicators such as half-life and overall citation count were found between contact lens related journals (shorter half-life and fewer citations) and the median values for the Ophthalmology thematic area of the JCR. Visual examination of all Ophthalmology journals uncovered a total of contact lens-related 156 papers, published in 28 different journals, with 27 articles each for *Contact Lens & Anterior Eye*, *Eye & Contact Lens* and *Optometry and Vision Science*. Significant differences in citation parameters were encountered between those articles published in contact lens and non-contact lens source journals.

Conclusions: These findings, which disclosed contact lenses to be a fertile area of research, may be of interest to researchers and institutions. Differences in bibliometric indicators are of relevance to avoid unwanted bias when conducting between and within discipline comparisons of articles, journals and researchers.

53 **KEY WORDS**

54 Citation Analysis; Contact Lenses; Impact Factor; Journal Citation Reports; Ophthalmology

INTRODUCTION

Since the introduction of the journal impact factor (IF) by Eugene Garfield¹ and its later development in the early 1960s, publications have been grouped in thematic areas based on their affinities and ranked by IF. Currently, about 5000 scientific journals are listed in the Journal Citation Reports (JCR), a yearly updated database published by Thomson Scientific which, in its 2011 Science Edition, included 176 subject categories. The IF describes the importance of a particular journal based on the number of citations in the current JCR year that refer to articles and reviews published by that journal in the previous two years and divided by that number of publications². Impact factor has been used, amongst others, by researchers, to decide upon the best destination for their manuscripts, by librarians, to manage journal subscriptions, and by universities on their **recruitment** policies (in this case a researcher is assessed in terms of the IF of the authored publications³). Thus, IF may be considered an indicator of the prestige of a publication, compelling some editors to redefine editorial policies such as manuscript acceptance/rejection **aimed at increasing the** IF of their journal.

Previous studies have evaluated different factors that may positively affect the IF of a publication^{4,5}, such as author and journal self-citation, specialization in review articles or publishing articles on trending, highly populated areas of research (as opposite to innovative, potentially groundbreaking work⁶). In addition, within the Ophthalmology subject category, it was found that although publication time lag (that is, time between acceptance and publication) was not correlated to IF values, journals with advance online publication of articles had higher IF than those without this feature⁷. Interestingly, in contrast with other branches of science, citation rates in Ophthalmology journals did not depend on the availability of the articles (open *versus* closed access), with other factors, including number of

authors, country of origin, language, funding and topic of the article, reflecting a more significant influence on citation⁸.

Citation frequency has also been documented to display notable differences not only between but also within fields of science, with fundamental subjects being awarded more citations than specialized areas of research and, in health sciences, with basic and diagnostic research commonly receiving an above average citation impact when compared with clinical research⁹⁻¹¹. This may result in unwanted bias when comparing IF between and within scientific disciplines, with some authors suggesting that journal IF should be compared only within discipline groupings¹².

The JCR Ophthalmology subject category has traditionally included ophthalmology, vision science and optometry journals, with substantial differences in citation rate, IF and citation half-life (defined as the median age of the articles that were cited that year, e.g., if the half-life of a journal in 2013 is 10, that means the citations from 2003-2013 are half of all the citations from that journal in 2013, with the other half of the citations preceding 2003). For instance, it may be assumed that journals devoted to oculoplastic research have a longer half-life than others delving in retinal research¹¹. With the recent incorporation to the JCR Ophthalmology subject category of two of the most influential publications in the contact lens field (*Eye & Contact Lens* [in 2010] and *Contact Lens & Anterior Eye* [in 2011]) it may be relevant to explore the characteristics of the contact lens related articles published within the ophthalmic literature in terms of research topics, IF and bibliometric indicators/citation parameters.

In a seminal paper by Efron, Brennan and Nichols, published in January 2012, the authors performed a complete citation analysis of the contact lens field, from the first article by Adolf Fick, dating from 1888, to February 2011¹³. Efron and co-workers conducted a search strategy consisting in providing the search engine of the Web of Science (Thomson Reuters, New York, NY) with a list of commonly employed terms in the contact lens field, thus compiling a total of

3096 articles, whereupon the most highly cited, influential papers were identified, and the leading authors, source journals, institutions and countries associated with those articles were acknowledged. However, although these authors presented an excellent historical review of the contact lens field, they did not attempt to explore the current topics of interest for researchers, nor the actual positioning of the contact lens publications within the framework of the ophthalmic literature.

It was the aim of this study to explore the citation parameters of the articles related to the contact lens field published in 2011 in both contact lens and non-contact lens source journals. For this purpose, bibliometric data from contact lens related journals was compared with the corresponding average values from the Ophthalmology subject category of the JCR. In addition, bibliographic references of all contact lens related articles published in 2011 in the Ophthalmology subject category of the JCR (that is, also including those from *Eye & Contact Lens* and *Contact Lens & Anterior Eye*) were examined to determine the total number of cited articles, the most highly cited journal and the number of author and journal self-cites, as well as the number of citations to other JCR and non-JCR contact lens, optometry, ophthalmology and non-ophthalmology journals.

MATERIALS AND METHODS

A single experienced optometrist (J.S.) accessed the Thompson Reuters Web of Science database in March 2013 to review all 58 journals listed under the subject category Ophthalmology in the 2011 edition of the JCR (published in June 2012). The same database was employed to recover information regarding number of issues and articles in 2011, 2-year IF, citing half-life, number of citations in 2011, journal self-citation percentage and most highly cited and highly citing journal in 2011 (*i.e.*, citations to and from other JCR journals) of these 58 journals, thus allowing for a comparison between the average bibliometric indicators of the Ophthalmology subject category and those from both contact lens related journals.

The same optometrist then successively visited the online editions of all the Ophthalmology journals and conducted a visual examination of all articles published in 2011 to determine those papers related to the contact lens field. Articles were investigated by title, abstract and, when available, list of key words. When in doubt, the full article was accessed and downloaded for careful examination. Only original articles, reviews and case reports published in 2011, irrespective of their publication-ahead-of-print date, were included in the analysis.

This process uncovered a total of 156 **contact lens related articles**, published in 28 different journals. The full version of these articles was downloaded and they were submitted to a detailed visual inspection to recover the following information from each article: total number of bibliographic references, number of journal and author self-cites and number of citations to other JCR-listed and non-JCR listed journals of contact lenses, optometry and **ophthalmology**.

In this study, no distinction was made between ophthalmology *per se* and vision science journals, *i.e.*, all journals listed in the JCR Ophthalmology subcategory were allocated to the ophthalmology subgroup, except for those commonly associated to optometry (*Optometry & Vision Science, Ophthalmic and Physiological Optics, Clinical and Experimental Optometry and Optometry*) and contact lenses (*Eye & Contact Lens* and *Contact Lens & Anterior Eye*) subjects.

Finally, the number of citations to other JCR-listed and non-JCR listed journals outside the thematic area of Ophthalmology was also recorded.

Data analysis

Statistical analysis of the data was performed with the SPSS software 19.0 for Windows. Albeit all data was numerical in nature, prior to statistical analysis it was examined for normality with the Kolmogorov-Smirnov test, revealing several instances of non-normal distribution. Therefore, where applicable, descriptive statistics is presented as median and range (minimum-maximum values). In addition, the Mann-Whitney test for unrelated samples was employed to examine differences in citation parameters between contact lens articles published in contact lens related journals and those published in non-contact lens related journals. A p-value < 0.05 was selected to denote statistical significance.

RESULTS

A preliminary review of the 2011 JCR Science Edition database revealed 176 different subject categories, with Ophthalmology placed in the 82nd position in terms of average IF, and with a total of 8319 published articles during 2011. The subject category Ophthalmology included 58 journals, more than half of which with one or more articles related to the contact lens field in 2011.

Table 1 provides a summary of relevant bibliometric indicators of the recent contact lens journals incorporated to the JCR database (*Contact Lens & Anterior Eye* and *Eye & Contact Lens*) referenced within the framework of the Ophthalmology thematic area. It may be observed that in journal 2-year IF, issues per year and percentage of journal self-cites, both contact lens journals are near the average value for the Ophthalmology subject category. However, their journal citing half-life, number of articles published in 2011 and total number of citations are lower than the corresponding average values for the Ophthalmology category. Of these bibliometrics, of particular relevance is the journal citing half-life: whereas, in average, half the citations of an article in the Ophthalmology subject category refer to previous papers published during the 6.5 previous years, articles published in contact lens related journals have shorter half-lives, of 4.7 and 4.5 years for *Eye & Contact Lens* and *Contact Lens & Anterior Eye*, respectively. This trend to cite more recent publications is an indicator of a faster evolving area of research.

It may be noted that, in overall, *Investigative Ophthalmology & Visual Science* is the most highly cited and citing journal in the Ophthalmology subject category. Interestingly, however, the most highly cited journal in *Contact Lens & Anterior Eye* is *Eye & Contact Lens*, which in turn defines *Contact Lens & Anterior Eye* as the source of most of the citations awarded to the articles of *Eye & Contact Lens*.

Of the 28 journals with articles related to the contact lens field, more than half of the articles were concentrated in four journals: *Contact Lens & Anterior Eye* (27), *Eye & Contact Lens* (27), *Optometry and Vision Science* (27) and *Investigative Ophthalmology & Visual Science* (22). However, it must be noted that, whereas in total number of contact lens related articles three publications were tied at the first rank, with 27 articles each, this position was occupied by *Contact Lens & Anterior Eye* alone when examining the ratio of contact lens related articles over total number of articles (54%).

The actual citation parameters of the 156 contact lens related articles are summarized in **Table 2**, in which articles are classified according to the main publication interest of their source journal (either non-contact lens or contact lens journals). It may be observed that the values of many citation parameters are very similar between both types of source journals (as described by either their median and range values). Indeed, both types of source journals have a similar total number of citations and percentage of journal self-cites, with slightly more author self-cites for the non-contact lens (9%) than for the contact lens source journals (5.8%), although this difference was not statistically significant. However, whereas the largest percentage of citations of both types of source journals are allocated to ophthalmology journals, articles published in contact lens source journals award more citations to optometry journals than contact lens journals, with the opposite trend being observed in non-contact lens source journals. In effect, statistically significant differences were found between contact lens and non-contact lens source journals in the percentage of citations to both JCR optometry journals ($Z=-3.384$; $p = 0.001$) and to JCR contact lens journals ($Z=-2.852$; $p = 0.004$), as well as to non-JCR optometry journals ($Z=-2.479$; $p = 0.013$). Although a large variability is present, the median percentage of citations to articles not listed in the JCR database is similar and very low for both types of source journals, with about 10% of citations referencing JCR listed journals outside the Ophthalmology subject category (citations to journals outside the JCR Ophthalmology subject category were evenly distributed amongst a large number of journals).

DISCUSSION

The present study aimed at exploring the citation parameters of the recent contact lens journals incorporated to the Ophthalmology subject category of the JCR, as well as those of the contact lens related articles published in 2011 in both contact lens and non-contact lens source journals.

In the first part of the study the JCR database was revised to record the most significant bibliometric parameters of the Ophthalmology subject category as a whole, and of both contact lens related journals in particular. It was revealed that, in general, values from the contact lens journals were not dissimilar from the average values for the Ophthalmology thematic area, with the exception of number of articles published in 2011 and total number of citations, both of which were lower for the contact lens journals, and journal citing half-life, with shorter half-lives for the contact lens journals. As per definition, a short half-life denotes that the contact lens field of research may be a faster evolving area of research than Ophthalmology in general.

The second part of the study uncovered significant differences in citation parameters between those contact lens related articles published in contact lens or non-contact lens journals. These findings suggest that the main topic of interest of the source journal may have an influence on the actual content of the published articles and on the references their authors chose to cite. It must be noted that, although it was beyond the scope of the present study, it would have been interesting to compare contact lens related articles with articles describing other areas of ophthalmic research. Notwithstanding this limitation, however, it was significant to observe that, out of 156 contact lens related articles, 54 of them were published in either *Contact Lens & Anterior Eye* or *Eye & Contact Lens*, that is, it may be assumed that many researchers working in the contact lens field opt for a contact lens related journal for the submission of

their manuscripts (although it would be very relevant to have information on the percentage of these manuscripts that were previously submitted to other, higher IF journals).

Overall, these results revealed the contact lens field of research to have particular citation characteristics when explored within the framework of the ophthalmic literature. The implications of these findings are not a triviality. Indeed, as noted above, it may be inappropriate to compare research institutions, authors or journals belonging to different disciplines or to different “microfields” of research within the same discipline, as inherent differences in fundamental bibliometric indicators (such as half-life) may result in erroneous assumptions regarding the performance of those institutions, authors or journals. This has led some authors to suggest that impact factors, as well as other bibliometric parameters, should only be compared within the same discipline, or with the same subspecialty of that discipline¹¹⁻¹².

Actually, for this and some of the other reasons exposed above, the use of IF has been widely criticised. Although there is no easy way to measure how useful an article is to clinicians in their daily clinical practice, by employing citation frequency or journal IF to determine this usefulness it may be overlooked that a particular citation may not credit or praise a particular piece of research, but serve to refute it instead¹⁴. Besides, the IF is associated to a particular journal, not to a particular article published in that journal, that is, whereas a given journal’s IF may be driven by only a few highly cited articles, all articles published during that year are awarded the same IF¹⁵. In summary, the awareness of the diverse faults of the IF described here has led more than 200 institutions and individual researchers to sign a set of recommendations, known as the San Francisco Declaration on Research Assessment (freely available at <http://www.ascg.org/SFdeclaration.html>), in which these and other pitfalls of research are exposed in detail¹⁶.

It must be noted that the present study did not assess the citation rate of the identified articles, that is, the authors and journals that cited those articles following their publication. As it has been documented that citations to articles published in a given year increase to a maximum between two and a six years after publication¹², citation analysis of articles published in 2011 shall be the subject of a future study. The findings of that study should be able to determine the validity of the preliminary assumptions offered by the present data.

In conclusion, contact lens research is a relatively new field of research which has not received much attention in terms of systematic reviews and meta-analyses, also matching the documented general lack of systematic reviews, and meta-analyses of published evidence in ophthalmology¹⁷. Indeed, as far as we know, the present study represents only the second attempt (after Efron and co-workers¹³) at conducting a bibliometric analysis of the contact lens field. As such, the findings of the present bibliometric and citation analysis of the contact lens journals and literature disclosed several relevant particularities (mainly in citing half-life and overall number of citations) which suggest that the contact lens field or research may be considered a subspecialty, such as optometry or vision science, within the Ophthalmology thematic area. These findings, which have important implications when employing bibliometric indicators to assess the performance of a given journal or researcher related to the contact lens field, also describe contact lenses as a rich, rewarding and attractive area of research for both novice and expert investigators.

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